94-160888/20 D25 E14 ~~INSP 92.10.28~~
INST FRANCAIS DU PETROLE *FR 2697246-A1
92.10.28 92FR-013080 *(94.04.29)* C07C 15/107, ~~27/00~~
D(11-A1B1, 11-D6) E(10-J2B3) N(6-B)

Prodn of phenyl=alkane(s) - by using catalyst based on modified zeolite Y

C94-073641
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The simultaneous prodn. of 2-, 3-, 4-, 5- and 6-phenyl alkanes is effected by the alkylation of benzene using a 9-16C linear olefin in the presence of a solid zeolite catalyst.

The catalyst comprises a matrix and a de-aluminised HY zeolite contg. hardly any extra-cellular Al, and having a Na content less than 0.25%, a cell parameter less than 24.55×10^{-10} m ; and a BET surface area greater than 300 m^2/g.

The process is carried out at 1-10 MPa and a temp. less than 300°C, spatial velocity of 0.5-50 and a benzene: olefin(s) molar ratio of 1-20.

USE

The phenyl-alkanes obtained are used in the formulation (after sulphonation) of bio-degradable detergents.

ADVANTAGES

The present invention overcomes safety and disposal problems which are incurred in the usual techniques using HF- and $AlCl_3$-based catalyst. The latter techniques also involve difficulties in sepn. of catalyst from the reaction prods.

The new catalyst are very active and resistant to de-activation, and they give selectivities similar to those obtd. in classical processes.

OLEFIN REACTANT

10-14C linear olefins are prefd.

PREFERRED CATALYST

The matrix is chosen from a clay, alumina, silica, magnesia, zirconia, oxides of titanium and boron, or a combination.

The Si:Al ratio is 8-70 (more pref. 15-25). The zeolite content of the catalyst is 20-98% (more pref. 40-98%).

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The cell parameter is between 24.39×10^{-10} m to 24.21×10^{-10} m. and the surface area is more than 450 m^2/g.

PREFERRED CONDITIONS

The prod. obtd. from the alkylation zone is fractionated into:
(a) a first fraction contg. unconverted benzene,
(b) a second fraction contg. at least one un-converted linear olefin;
(c) a third fraction contg. phenyl-alkanes; and
(d) a fourth fraction contg. at least one poly-alkyl benzene, which is re-cycled to the alkylation reactor.

Pref. at least part of the first and second fractions is recycled to the reactor zone.

EXAMPLE

A catalyst was prepared using as prim. material a zeolite NaY of formula $NaAlO_2(SiO_2)_{2.5}$ which had the following characteristics: global Si:Al atomic ratio = 2.5; crystal parameter (a_0) = 24.69×10^{-10} m; water vapour adsorption capacity (25°C) = 26%; surface area 880 m^2/g.

This was subjected to 5 exchanges with 2M NH_4NO_3 soln. at 95°C for 1.5 hr, to give a zeolite NH_4Y contg. 0.95% Na. This was stabilised in an oven at 770°C for 4 hrs. and then subjected to an acid treatment with 3N.HNO_3 (9 cm^3/g of solid) at 95°C for 3 hrs. followed by a similar treatment, but with 0.5N.HNO_3.

The zeolite obtd. contain 0.2% Na, had an Si:Al global atomic ratio of 28, crystalline parameter (a_0) equal to 24.24×10^{-10} m, surface area 770 m^2/g, and water absorption capacity of 5%. It was formed into extrudates with 20% of alumina and calcined at 550°C. This was designated catalyst (B).

A similar catalyst (but not conforming to the invention) was prepared from mordenite zeolite (catalyst A).

The 2 catalysts were tested in the alkylation of benzene by 1-dodecene at 50°C, 4 MPa, LHSV 3 x vol. of catalyst, and benzene to 1-dodecene ratio of 5.5. The results are as follows:

Charge compsn. (%wt)	Catalyst A	Catalyst B
Benzene	71.7	72.3
1-dodecene	28.3	27.7
Prod. compsn. % wt.		
2-phenylalkane	77.34	26.92
3-phenylalkane	10.83	20

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4-phenylalkane	0.98	19
5-phenylalkane	0	11.5
6-phenylalkane	0	11.48
Di:dodecylbenzene	10.10	10
Heavy residue	0.75	1.1

From this it can be seen that only catalyst (B), contg. de-aluminised zeolite Y, gave a homogeneous distribution of phenyl-alkanes (similar to that generally obtd. with HF or $AlCl_3$ catalysts), whereas catalyst A gave mainly 2- and 3-phenylalkanes. (13pp2003EDDwgNo0/0)

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